WHAT IS CLAIMED IS:

1. A NOx sensor comprising:

a gas detection chamber composed of an internal space surrounded by zirconia solid electrolyte substrates having oxygen ion conductivity;

a NOx sensing cell including a NOx sensing electrode fixed onto said zirconia solid electrolyte substrate in said gas detection chamber, said NOx sensing electrode being active to NOx and oxygen, and a reference electrode fixed onto said zirconia solid electrolyte substrate, said reference electrode being active to at least oxygen;

a NOx conversion pumping cell including a NOx conversion electrode fixed onto said zirconia solid electrolyte substrate in said gas detection chamber, said NOx conversion electrode being active to NOx and oxygen, and a counter electrode to be paired with said NOx conversion electrode, said counter electrode being fixed onto said zirconia solid electrolyte substrate, being active to oxygen;

voltage applying means for applying a predetermined voltage to said NOx conversion pumping cell;

a first gas treatment chamber communicating with said gas detection chamber and having a gas inlet leading to an atmosphere of a gas to be detected, an inorganic

porous member being loaded into said first gas treatment chamber; and

means for measuring a potential difference between said NOx sensing electrode and said reference electrode while converting NOx in the gas to be detected into single component after a reducing gas in the gas to be detected is oxidized in said first gas treatment chamber, and thereby detecting a total NOx concentration in the gas to be detected.

2. The NOx sensor according to claim 1, wherein an electrochemical oxygen pumping cell ((oxygen supplying pumping cell)) for supplying oxygen to at least said first gas treatment chamber is arranged between said first gas treatment chamber loaded with said porous member and said gas detection chamber containing said NOx detection cell.

3. The NOx sensor according to claim 2, wherein said oxygen supplying pumping cell for supplying oxygen to at least said first gas treatment chamber is arranged in a second gas treatment chamber communicating with said first gas treatment chamber and said gas detection chamber.

4. The NOx sensor according to claim 1, wherein said first gas treatment chamber is formed across one of said zirconia solid electrolyte substrates surrounding

said gas detection chamber, or said gas detection chamber and second gas treatment chamber, and communicates with said gas detection chamber or said second gas treatment chamber through a gas diffusion hole or a porous member arranged in said zirconia solid electrolyte substrate.

5. The NOx sensor according to claim 1, wherein said porous member loaded into said first gas treatment chamber has a porosity of 5-40%.

6. The NOx sensor according to claim 1, wherein said porous member loaded into said first gas treatment chamber comprises chiefly at least one selected from the group consisting of zeolite, zirconia, alumina, and silica, and/or a compound thereof.

7. The NOx sensor according to claim 1, wherein said porous member loaded into said first gas treatment chamber carries catalytic oxide and/or precious metal.

8. The NOx sensor according to claim 7, wherein said catalytic oxide comprises ceria or a solid solution of ceria and zirconia.

9. The NOx sensor according to claim 7, wherein said catalytic precious metal to be carried by said porous member loaded into said first gas treatment chamber

comprises one selected from the group consisting of Pt, Pd, Ir, Au, Ru, Ag, Rh, and a mixture thereof.

10. The NOx sensor according to claim 7, wherein the amount of said catalytic precious metal to be carried by said porous member loaded into said first gas treatment chamber falls within the range of 0.1 and 30 mg/cm^3 with respect to a bulk volume of said porous member.

11. The NOx sensor according to claim 1, further comprising:

an oxidation catalyst pumping cell including an oxidation catalyst electrode composed of said inorganic porous member loaded into said first gas treatment chamber, said oxidation catalyst electrode serving as an anode electrode, and a cathode electrode to be paired with said oxidation catalyst electrode, said cathode electrode being arranged on a zirconia solid electrolyte substrate outside said gas detection chamber and being active to oxygen; and

voltage applying means for applying a predetermined voltage to said oxidation catalyst pumping cell.

12. The NOx sensor according to claim 2, wherein said anode electrode of said oxygen supplying pumping cell is an oxidation catalyst electrode active to the gas

to be treated and oxygen.

13. The NOx sensor according to claim 11, wherein said oxidation catalyst electrode comprises mainly an oxygen-ion-conductive solid electrolyte and a precious metal selected from the group consisting of Pt, Pd, Ir, Au, Rh, a mixture thereof, and an alloy thereof.

14. The NOx sensor according to claim 11, wherein said oxidation catalyst electrode comprises chiefly an oxygen-ion-conductive solid electrolyte and a metal oxide active to said reducing gas.

15. The NOx sensor according to claim 13, wherein said oxygen-ion-conductive solid electrolyte to be added to said oxidation catalyst electrode falls within the range of 20 and 50% by volume with respect to the volume of said oxidation catalyst electrode.

16. The NOx sensor according to claim 2, wherein said cathode electrode of said oxygen supplying pumping cell or said oxidation catalyst pumping cell is installed in a duct communicating with the gas to be detected.

17. The NOx sensor according to claim 16, further comprising means for measuring a potential difference between said cathode electrode of said oxidation catalyst

pumping cell exposed to the gas to be detected and said reference electrode of said NOx detection cell or said counter electrode of said NOx conversion pumping cell communicating with an atmospheric air.

18. The NOx sensor according to claim 11, wherein at least one gas inlet is formed in the top or bottom of said first gas treatment chamber.

19. A NOx sensor comprising:

a gas detection chamber composed of an internal space surrounded by zirconia solid electrolyte substrates having oxygen ion conductivity;

a NOx detection cell including a NOx sensing electrode fixed onto said zirconia solid electrolyte substrate in said gas detection chamber, said NOx sensing electrode being active to NOx and oxygen, and a reference electrode fixed onto said zirconia solid electrolyte substrate, said reference electrode being active to at least oxygen;

a NOx conversion pumping cell including a NOx conversion electrode fixed onto said zirconia solid electrolyte substrate in said gas detection chamber, said NOx conversion electrode being active to NOx and oxygen, and a counter electrode to be paired with said NOx conversion electrode, said counter electrode being fixed onto said zirconia solid electrolyte substrate, being

active to oxygen;

voltage applying means for applying a predetermined voltage to said NOx conversion pumping cell;

a first gas treatment chamber communicating with said gas detection chamber and having a gas inlet leading to an atmosphere of a gas to be detected;

an oxidation catalyst pumping cell including an oxidation catalyst electrode arranged in said first gas treatment chamber, said oxidation catalyst electrode having a gas channel, being active to a reducing gas and oxygen, and serving as an anode electrode, and a cathode electrode to be paired with said oxidation catalyst electrode, said cathode electrode being arranged on a zirconia solid electrolyte substrate outside said gas detection chamber and being active to oxygen;

voltage applying means for applying a predetermined voltage to said oxidation catalyst pumping cell; and

means for measuring a potential difference between said NOx sensing electrode and said reference electrode while converting NOx in the gas to be detected into NO_2 or NO after the reducing gas in the gas to be detected is oxidized in said first gas treatment chamber, and thereby detecting the total NOx concentration in the gas to be detected.

20. The NOx sensor according to claim 19, wherein said gas channel arranged in said first treatment chamber is composed of at least one narrow path arranged along the direction of flow of the gas to be detected.

21. The NOx sensor according to claim 20, wherein a diffusion resistance defined by the ratio (S/L) of the total cross-sectional area S of said path to the length L of said path falls within the range of 0.001 and 0.1.

22. The NOx sensor according to claim 1, wherein said reference electrode of said NOx detection cell is installed in said gas detection chamber.

23. The NOx sensor according to claim 1, comprising:

said reference electrode of said NOx detection cell being installed across said zirconia solid electrolyte substrate constituting said gas detection chamber, in a duct leading only to the air outside of said gas detection chamber;

an oxygen sensing electrode arranged in said detection chamber, said oxygen sensing electrode being active to oxygen alone; and

means for detecting the total NOx concentration while correcting the same for a potential difference between said reference electrode and said NOx sensing

electrode and a potential difference between said reference electrode and said oxygen sensing electrode.

24. The NOx sensor according to claim 1, wherein said gas inlet arranged in said first gas treatment chamber is covered with a porous protective film.